

SPECIFICATION

CROSS REFERENCE TO RELATED APPLICATIONS

Priority is claimed with respect to Japanese Application No. 11/191040 filed July 5, 1999, in the Japanese Patent Office, the disclosure of which is incorporated herein by reference.

TITLE OF THE INVENTION

ULTRASONIC SEALING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention:

The present invention relates to an ultrasonic sealing apparatus for transversely sealing a tubular laminated packaging material filled with a content such as liquid beverage, and more particularly to an ultrasonic sealing apparatus provided with an opposing jaw having a specified shape for improving a sealability by controlling a molten thermoplastic resin flow.

2. Description of the Related Art:

Hitherto, as a packaging machine in which a packaging material web for a rectangular parallelepiped packaging container filled with a juice, etc. is used by being sterilized, there has been known a filling and packaging machine shown in

Fig.1. In summary, the filling and packaging machine comprises a rewinder 2 supporting a laminated packaging material web 1 in rolled state, a sterilization device 3 for sterilizing the plate-shaped laminated packaging material web successively rewound from the rewinder, a longitudinal sealing section 4 for sealing longitudinal both end portions of the sterilized laminated packaging material web and thereby forming a tubular laminated packaging material web, a liquid supply tube 5 for filling a fluid into the web formed in tubular form, a transverse sealing device 7 for transversely sealing the tubular laminated packaging material web in a direction perpendicular to the longitudinal direction thereof with a fluid while feeding downward a tube filled with the content by a length substantially corresponding to one package and, at the same time, continuously forming a pillow-shaped container 6 whose sectional shape is rectangle, and a shaping device for forming the pillow-shaped container 6 into a rectangular parallelepiped container 8 which is a final form by folding its end portions. And, the transversely sealing device 7 is composed of a sealing unit, a sealing jaw for fixing the sealing unit, and driving means for driving the sealing jaw.

Further, as the ultrasonic sealing apparatus, besides an ultrasonic sealing apparatus which comprises a piezoelectric driving unit having a piezoelectric ceramic

plate or a magnetostriction driving unit, that is connected to an AC supply source, and a horn having an elongated sealing face, and which is characterized by further having one or more reaction bodies forming a half wavelength together with the horn (Japanese Patent Laid-Open No. 2231/1995), there have been known many ultrasonic sealing apparatuses (Japanese Patent Publication No. 22784/1987, Japanese Patent Publication No. 2544450/1996, Japanese Patent Laid-Open No. 33121/1995, Japanese Patent Laid-Open No. 92046/1981, Japanese Patent Laid-Open No. 15741/1994, and the like).

Among these ultrasonic sealing apparatuses, as one characterized by a shape of action face of an opposing jaw for pressing a laminated packaging material in cooperation with the sealing face of the horn, there has been known an ultrasonic sealing apparatus for liquid containers for sealing opening portions at upper and lower ends of a horn cylindrical liquid container having an overlapping bonded portion nearly at a center of a barrel portion consisting of a horn and an anvil, wherein a band-shaped ridge is provided nearly at a center of a face of the horn butting against a portion to be sealed, a concave groove perpendicular to the ridge is provided nearly at a center of a face of the anvil butting against the portion to be sealed, a bottom portion of the concave groove is made into a two-step structure and its step portion and both end portions are tapered, and an acute angle protruded slant face

extending sideward is provided at an end portion of the center of the bottom portion (Japanese Utility Model Laid-Open No. 147408/1988, Registered Utility Model No. 3004786).

As shown in Fig.2, in case where a tubular laminated packaging material 11 filled with a content such as liquid beverage is transversely ultrasonic sealed with a fluid by using a sealing jaw 10 consisting of a horn and an opposing jaw 20, the tubular laminated packaging material is pressed and, as a result, a thickness of a longitudinally sealed three-ply portion 12 becomes larger than that of other two-ply portion. Therefore, there has been found by the inventors of the present invention a problem that steps are generated in the vicinity of both end portions of the longitudinally sealed portion and thus a sealing pressure becomes uneven, so that a tunnel (through passage) seldom occurs in the step portions, thereby generating a sealing failure.

SUMMARY OF THE INVENTION

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A problem of the invention is to provide an ultrasonic sealing apparatus capable of preventing the sealing failure owing to the tunnel (through passage) seldom occurring in the step portions in the vicinity of both end portions of the longitudinally sealed portion when the tubular laminated packaging material is transversely ultrasonic sealed with a fluid and the like.

In order to solve the above problem, the inventors of the present invention studied about an ultrasonic sealing in which a laminated packaging material was made into a tubular form and the tubular laminated packaging material was transversely heat sealed with a fluid, and there was provided such a means similar to means practically used in a high frequency heat sealing apparatus that a ridge is provided in a high frequency coil (heating source), i.e., a ridge for applying a strong pressing force to a sealing face of an ultrasonic horn (heating source). As a result, it was found that it became difficult to maintain an evenness in vibration owing to the ridge provided on the sealing face of the horn and, for this reason, a new sealing failure occurred.

Accordingly, differing from a conventional solving method in which a shape for improving a sealability is given to the sealing face of a heating source side, the ridge was provided on an action face of an opposing jaw for pressing a laminated packing material in cooperation with the sealing face of the horn. As a result, it was found that this was somewhat effective for preventing the tunnel from occurring, but a problem that the laminated packaging material was injured by the ridge occurred newly. Therefore, it was earnestly studied about means for increasing the pressing force applied to an action face without providing a protruded portion such as the ridge. As a result, it was found that if a center portion in

longitudinal direction, of an action face of the opposing jaw, against which a longitudinally sealed portion of the three-ply portion butted was formed into an action face narrower than both end portions, a necessary pressing force could be evenly applied to the longitudinally sealed portion of the three-ply portion without injuring the laminated packaging material, and thereby the invention was completed.

Further, in order to solve the above problem, the inventors of the present invention studied about an opposing jaw in an ultrasonic sealing apparatus in which a laminated packaging material is formed into a tubular form and the tubular laminated packaging material is transversely heat sealed with a fluid, by manufacturing those having action faces of various shapes by way of trial. During a process of the above study, it was found that there was such a case that the tubular laminated packaging material was rotated about a center axis of the tube and so a longitudinally sealed portion of the three-ply portion somewhat deviated from a regular position, i.e., a relief center position of the opposing jaw shown in Fig.2, and that, as a result, a sufficient pressing force was not applied to either of the step portions in the vicinity of both end portions of the longitudinally sealed portion. Accordingly, it was earnestly studied about means capable of applying an even pressing force to both of step portions in the vicinity of both end portions of the longitudinally sealed

portion even if the longitudinally sealed portion deviated from the regular position. As a result, it was found that if, at a center portion in a longitudinal direction of an action face of the opposing jaw, a recess having a circular shape and the like in section (relief shape was made an R form) was formed along a direction perpendicular to the longitudinal direction of the action face, it was possible to evenly apply a necessary pressing force to the longitudinally sealed portion of the three-ply portion, and thereby the invention was completed.

That is, the present invention relates to an ultrasonic sealing apparatus, in which a laminated packaging material containing at least a thermoplastic resin layer is formed into a tubular form and the tubular laminated packaging material is transversely ultrasonic sealed, comprising a horn having an elongated and flat sealing face and an opposing jaw having an elongated action face pressing the laminated packaging material in cooperation with the sealing face of the horn, characterized in that a center portion in longitudinal direction of an action face of the opposing jaw is formed into an action face narrower than both end portions (claim 1); an ultrasonic sealing apparatus according to claim 1, characterized in that the laminated packaging material contains a paper layer (claim 2); an ultrasonic sealing apparatus according to claim 1 or 2, characterized in that the transverse ultrasonic sealing is an ultrasonic sealing with

a fluid (claim 3); an ultrasonic sealing apparatus according to any of claims 1 to 3, characterized in that a length of a center portion, in longitudinal direction of the action face of the opposing jaw, formed into the action face narrower than both end portions is at least larger than a length of a longitudinally sealed three-ply portion of the tubular laminated packaging material under a pressed state (claim 4); an ultrasonic sealing apparatus according to any of claims 1 to 4, characterized in that a width of the narrow action face of the center portion in longitudinal direction is $1/4$ to $1/2$ of a width of an action face in the both end portions (claim 5); an ultrasonic sealing apparatus according to any of claims 1 to 5, characterized in that the narrow action face of the center portion in longitudinal direction has a recess formed along a direction perpendicular to the longitudinal direction of the action face (claim 6); an ultrasonic sealing apparatus according to claim 6, characterized in that the formed recess is a recess having an arc shape in section (claim 7); and an ultrasonic sealing apparatus according to any of claims 1 to 7, characterized in that, when the laminated packaging material is formed into the tubular form, the tubular laminated packaging material is a tubular laminated packaging material formed into the tubular form by using a sealing tape (claim 8).

Further, the present invention relates to an ultrasonic

sealing apparatus, in which a laminated packaging material containing at least a thermoplastic resin layer is formed into a tubular form and the tubular laminated packaging material is transversely ultrasonic sealed, comprising a horn having an elongated and flat sealing face and an opposing jaw having an elongated action face pressing the laminated packaging material in cooperation with the sealing face of the horn, characterized in that, at a center portion in longitudinal direction of an action face of the opposing jaw, a recess is formed along a direction perpendicular to the longitudinal direction of the action face (claim 9); an ultrasonic sealing apparatus according to claim 9, characterized in that the laminated packaging material contains a paper layer (claim 10); an ultrasonic sealing apparatus according to claim 9 or 10, characterized in that the transverse ultrasonic sealing is an ultrasonic sealing with a fluid (claim 11); an ultrasonic sealing apparatus according to any of claims 9 to 11, characterized in that a length of a center portion in longitudinal direction of the action face of the opposing jaw is at least larger than a length of a longitudinally sealed three-ply portion of the tubular laminated packaging material under a pressed state (claim 12); an ultrasonic sealing apparatus according to any of claims 9 to 12, characterized in that the formed recess is a recess having an arc shape in section (claim 13); and an ultrasonic sealing apparatus

according to any of claims 9 to 13, characterized in that, when the laminated packaging material is formed into the tubular form, the tubular laminated packaging material is a tubular laminated packaging material formed into the tubular form by using a sealing tape (claim 14).

As the laminated packaging material used in the present invention, any laminated packaging material may be used so long as it contains at least a thermoplastic resin layer. Concretely, it is possible to exemplify a laminated body comprising an inmost thermoplastic resin such as polyethylene layer capable of heat sealing by being molten by means of ultrasonic heating, a paper sheet for maintaining a rigidity of container, an aluminum foil layer or a synthetic resin film layer for preventing air, microbes or the like from permeating into the container, and the like. In case of a high frequency heat sealing, an electrically conductive material such as aluminum foil is an indispensable laminating material but, in case of an ultrasonic heat sealing, it is not always necessary, and an oxygen non-permeable synthetic resin film can be used in place of the aluminum foil and the like. Further, in case where the laminated packaging material is formed into a tubular form by being longitudinally sealed, it is also possible to perform the longitudinal sealing by using, separately from the laminated packaging material, a sealing tape consisting of a synthetic resin film and the like, for preventing a content

from permeating from an end face of the packaging material. In this case, it follows that the longitudinally sealed portion of the tubular laminated packaging material is longitudinally sealed under a three-ply state because there exists the sealing tape layer in addition to the two-ply laminated packaging material.

In the present invention, as an apparatus in which a laminated packaging material is formed into a tubular form and the tubular laminated packaging material is transversely ultrasonic sealed with a fluid, any ultrasonic sealing apparatus suffices so long as it comprises a horn having an elongated and flat sealing face and an opposing jaw having an elongated action face for pressing the laminated packaging material in cooperation with the sealing face of the horn. And besides conventional known ultrasonic sealing apparatuses, for example as shown in Fig.3, it is possible to exemplify an ultrasonic sealing apparatus 17 which was developed by the present inventors, which comprises at least one horn 14 having two elongated and flat sealing faces 13 for sealing the packaging material in longitudinal direction and plural converters 15 provided standing on a side reverse to the sealing faces of the horn 14 and resonating the horn, whose length is a length of one wavelength, and whose fixing position (attaching flange) 16 to a sealing jaw is a knot plane (WO99/48759).

In the present invention, in case where the horn which is a heating member having a heating source is made a sealing jaw, "opposing jaw" is used as a term opposing to the sealing jaw and means one of pressing members, which has no heating source. The opposing jaw is composed of an opposing jaw body and an opposing jaw working portion. And, in a filling and packaging machine of this kind, generally two pairs of pressing members each consisting of a sealing jaw and an opposing jaw are used, and two sealed portions are formed by being heat sealed by means of the respective pairs of pressing members. And, it is adapted such that packing containers each formed into a pillow-shaped shape are separated by being cut between the two sealed portions.

In the above opposing jaw working portion of the opposing jaw in the ultrasonic sealing apparatus of the present invention, there is formed an elongated action face for pressing the laminated packaging material in cooperation with the sealing face of the horn and, in one aspect, the invention relates to an ultrasonic sealing apparatus in which a center portion in longitudinal direction of the action face of the opposing jaw is formed into an action face narrower than both end portions. Here, "a center portion in longitudinal direction" means a position on the action face where a longitudinally sealed three-ply portion of the tubular laminated packaging material at least butts against the action

face of the opposing jaw, and both end portions of the action face are excluded, but a center in longitudinal direction of the action face may not necessarily be included. And, in this ultrasonic sealing apparatus, it is desirable that a length of the center portion in longitudinal direction of the opposing jaw working portion's action face formed into the action face narrower than the both end portions is at least longer than a length of the longitudinally sealed three-ply portion of the tubular laminated packaging material under a pressed state.

Further, it is desirable that a width of the narrow action face of the center portion in longitudinal direction is $1/4-1/2$, especially about $1/3$, of those of the action faces of the both end portions. And, since a pressure (P) is found as a quotient ($P = F/S$) obtained by means of dividing a force (F) by an area (S), in case where the width of the action face is narrowed to $1/3$ for instance, it follows that a pressure applied hereto is three times that of before being narrowed, so that a sufficient pressing force can be applied to the three-ply longitudinally sealed portion, thereby making it possible to prevent the tunnel from occurring. As to the action face formed narrowly, in case where it is formed in the action face nearly parallel to a longitudinal direction of the action face such as a center portion in width direction, a container's interior side and a cutting side, a position in width direction is not limited especially.

It is also possible to form, in the action face formed narrowly, a recess having an arc shape and the like in section along a direction perpendicular to the longitudinal direction of the action face. By providing such a recess, even if the tubular laminated packaging material is rotated about a center axis of the tube as the axis of rotation and so a longitudinally sealed portion of the three-ply portion somewhat deviates from a regular position, it follows that step portions in the vicinity of both end portions of the longitudinally sealed portion butt against the recessed action face formed narrowly, so that it is possible to evenly apply a sufficient pressing force required for an excellent seal to the longitudinally sealed portion of the three-ply portion. As such a recess, the arc shape in section is desirable. However, any shape may suffice so long as it can apply the sufficient pressing force required for the excellent seal to step portions in the vicinity of the both end portions of the longitudinally sealed portion of the three-ply portion even in case where the longitudinally sealed portion of the three-ply portion somewhat deviates from the regular position.

Further, the present invention relates to an ultrasonic sealing apparatus characterized in that an elongated action face pressing the laminated packaging material in corporation with a sealing face of a horn is provided in the opposing jaw working portion of the opposing jaw, and a recess having an

arc shape and the like in section is formed in a center portion in longitudinal direction of the action face of the opposing jaw along a direction perpendicular to the longitudinal direction of the action face. By providing such a recess, even if the tubular laminated packaging material is rotated about a center axis of the tube as the axis of rotation and so a longitudinally sealed portion of the three-ply portion somewhat deviates from a regular position, it follows that step portions in the vicinity of both end portions of the longitudinally sealed portion butt against the recessed action face formed by the recess, so that it is possible to evenly apply a sufficient pressing force required for an excellent seal to the longitudinally sealed portion of the three-ply portion. As such a recess, the arc shape in section is desirable. However, any shape may suffice so long as it can apply the sufficient pressing force required for the excellent seal to step portions in the vicinity of both end portions of the longitudinally sealed portion even in case where the longitudinally sealed portion of the three-ply portion somewhat deviates from the regular position.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig.1 is a view explaining a process until a paper packaging container is formed by a conventional filling and packaging machine;

Fig.2 is a view explaining a state that a tubular laminated packaging material is pressed in case where a tubular laminated packaging material is transversely sealed;

Fig.3 is a schematic perspective view of an ultrasonic wave generating device capable of being used in an ultrasonic sealing apparatus of the present invention;

Fig.4 is a schematic perspective view showing a main portion of an opposing jaw in which a center portion of an action face is formed into a narrow action face in the ultrasonic sealing apparatus of the present invention;

Fig.5 is a front view showing the main portion of the opposing jaw in which the center portion of the action face is formed into the narrow action face in the ultrasonic sealing apparatus of the present invention;

Fig.6 is a front view showing an opposing jaw of another mode in which a center portion of an action face is formed into a narrow action face in the ultrasonic sealing apparatus of the present invention;

Fig.7 is an enlarged view showing a main portion in Fig.6;

Fig.8 is a sectional view seen along an arrow line A-A in Fig.6;

Fig.9 is a view showing a main portion of an opposing jaw in which notches are formed in a center portion of an action face, and which is shown as a reference example;

Fig.10 is a view showing a main portion of an opposing

jaw in which notches are formed in a center portion of an action face, and which is shown as a reference example of another mode;

Fig.11 is a schematic perspective view showing a main portion of an opposing jaw in which a recess having an arc shape in section is formed in an action face formed narrowly in the ultrasonic sealing apparatus of the present invention;

Fig.12 is a side view showing the main portion of the opposing jaw in which the recess having the arc shape in section is formed in the action face formed narrowly in the ultrasonic sealing apparatus of the present invention;

Fig.13 is a front view showing a main portion of an opposing jaw in which a recess corresponding to a shape of a longitudinally sealed portion formed narrowly is formed in the ultrasonic sealing apparatus of the present invention;

Fig.14 is a side view showing the main portion of the opposing jaw in which the recess corresponding to the shape of the longitudinally sealed portion formed narrowly is formed in the ultrasonic sealing apparatus of the present invention;

Fig.15 is a schematic perspective view showing a main portion of an opposing jaw in which a recess having an arc shape in section is formed in a center portion in longitudinal direction of an action face in the ultrasonic sealing apparatus of the present invention;

Fig.16 is a side view showing the main portion of the opposing jaw in which the recess having the arc shape in section

is formed in the center portion in longitudinal direction of the action face in the ultrasonic sealing apparatus of the present invention;

Figs.17 to 22 are views showing main portions of opposing jaws in which recesses of various shapes are formed in center portions of action faces in the ultrasonic sealing apparatus of the present invention;

Fig.23 is a front view showing an opposing jaw having an opposing jaw working portion of a semicircular shape in section in the ultrasonic sealing apparatus of the present invention; and

Fig.24 is a schematic perspective view showing a main portion of the opposing jaw having the opposing jaw working portion of the semicircular shape in section in the ultrasonic sealing apparatus of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Hereunder, embodiments and the like of the present invention are detailedly described on the basis of Figs.4-24, but a technical scope of the invention is not limited to the embodiments. Incidentally, in Figs.4-24, 20 denotes an opposing jaw, 21 an opposing jaw body, 22 an opposing jaw working portion, 23 both end portions in longitudinal direction of an action face, 24 a narrow action face of a center portion in longitudinal direction of the action face, 25 a recess having

an arc shape in section, 26 a recess corresponding to a shape of a longitudinally sealed portion, and 27 recesses of various shapes, respectively.

In Fig.4 and Fig.5, there is shown a main portion of the opposing jaw 20 in which the center portion in longitudinal direction of the action face formed in the opposing jaw working portion 22 provided on one face of the opposing jaw body 21 of the opposing jaw 20 is formed into the action face 24 narrower than the both end portions 23. The action face 24 formed narrowly is formed nearly parallel to a longitudinal direction of the action face of the center portion in width direction. Further, in Figs.6-8, there are shown the opposing jaws 20 of different types. The opposing jaw 20 shown in Figs.6-8 is provided with the two opposing jaw working portions 22 on one face of the opposing jaw body 21; The center portion in longitudinal direction of the action face of the opposing jaw working portion 22 formed outward is formed into the action face 24 narrower than the both end portions 23. The opposing jaws having the narrow action face 24, especially the opposing jaw shown in Fig.4 and Fig.5, is superior in its sealability to the opposing jaws provided with the opposing jaw working portions 22 whose main portions are respectively shown in Fig.9 and Fig.10 and which have notches in the center portion in longitudinal direction of the action face.

Further, in Fig. 11 and Fig.12, there is shown a main

portion of the opposing jaw 20 in which the recess 25 having an arc shape in section is formed in the action face 24 formed narrowly along a direction perpendicular to the longitudinal direction of the action face. Incidentally, in Fig.12, there is shown a state just before the three-ply portion 12 butts against the recess 25 having an arc shape in section after the tubular laminated packaging material 11 has been pressed. In the ultrasonic sealing apparatus having this opposing jaw 20, a length of the center portion in longitudinal direction of the action face of the opposing jaw working portion 22, which is formed into the action face 24 narrower than the both end portions 23, is larger than that of the longitudinally sealed three-ply portion 12 of the tubular laminated packaging material 11 under a pressed state.

In Fig. 13 and Fig.14, there is shown a main portion of the opposing jaw in which the recess 26 corresponding to a shape of the longitudinally sealed portion is formed in the action face 24 formed narrowly along a direction perpendicular to the longitudinal direction of the action face. Further, in Fig.14, there is shown a state just before the three-ply portion 12 butts against the recess 26 corresponding to the shape of the longitudinally sealed portion after the tubular laminated packaging material 11 has been pressed.

In Fig.15 and Fig.16, there is shown a main portion of the opposing jaw 20 in which the recess 25 having an arc shape

in section is formed along a direction perpendicular to the longitudinal direction of the action face in the center portion in longitudinal direction of the action face formed in the opposing jaw working portion 22 provided on one face of the opposing jaw body 21 of the opposing jaw 20. As shown in Fig.16, a length of the recess 25 having an arc shape in section of the center portion in longitudinal direction of the action face of the opposing jaw 20 is larger than that of the longitudinally sealed three-ply portion of the tubular laminated packaging material under a pressed state.

Further, in Fig.17-Fig.22, there are shown main portions of the opposing jaws 20 in which the recesses 27 of various shapes are formed along a direction perpendicular to the longitudinal direction of the action faces in the center portions in longitudinal direction of the action faces formed in the opposing jaw working portions 22 provided on one face of the opposing jaw bodies of the opposing jaws. In Fig.17, there is shown the opposing jaw having the action face in which step portions are slantingly formed and end portions of the recess are formed in arc shapes in section; in Fig.18, the opposing jaw having the action face in which the step portions are slantingly formed and the end portions of the recess are formed in obtuse angles; in Fig.19, the opposing jaw having the action face in which the end portions of the recess are formed in arc shapes in section; in Fig. 20, the opposing jaw

having the action face in which inclinations of step portions are different and the end portions of the recess are formed in obtuse angles; in Fig. 21, the opposing jaw having the action face in which one end portion of the recess is formed in an obtuse angle and the other is formed in an arc shape in section; and in Fig. 22, the opposing jaw having the action face in which the inclinations of the step portions are equal and the end portions of the recess are formed in obtuse angle; respectively.

In Fig. 23 and Fig. 24, there is shown the opposing jaw 20 in which the opposing jaw working portion 22 having a semicircular shape in section is provided on one face of the opposing jaw body 21 of the opposing jaw 20 and the center portion in longitudinal direction of the action face formed in the opposing jaw working portion 22 is recessed in comparison with its both end portions. Since this opposing jaw 20 is provided with the opposing jaw working portion 22 having a semicircular shape in section, a degree of injuring a surface of the laminated packaging material is small.

According to the present invention, it is possible to prevent a sealing failure owing to the tunnel (through passage) seldom occurring in the step portions in the vicinity of the both end portions of the three-ply portion owing to an uneven sealing pressure in the longitudinally sealed portion when transversely ultrasonic sealing the tubular laminated

packaging material below the liquid surface and the like. Further, even if the longitudinally sealed portion is deviated from the regular position of the opposing jaw, the sealing can be surely performed.